# NEAR FIELD COMMUNICATIONS: FEATURES AND CONSIDERATIONS

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**ABSTRACT.** The increased availability of wireless technologies to transfer data and information between mobile devices is changing the service expectations of medical library customers. In response, medical librarians have investigated and implemented a variety of services that utilize the emerging wireless technologies being built into each generation of mobile devices. One such wireless technology that is now available on a growing number of smartphones is known as Near Field Communication (NFC). This column describes the basic features of the near field communications and discusses considerations that can help guide libraries when developing their mobile strategies.

**KEYWORDS.** Android, applications, BlackBerry, iPad, iPhone, mobile devices, near field communication, NFC, smartphone software development.

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The increased availability of wireless technologies to transfer data and information between mobile devices is changing the service expectations of medical library customers. While there are challenges in meeting the growing mobile needs of library users, the portability and convenience of portable devices is creating new possibilities for innovative library services. In response , medical librarians have investigated and implemented a variety of services that utilize the emerging wireless technologies being built into each generation of mobile devices. One such wireless technology now available is known as Near Field Communication (NFC). While a library's decision to allocate resources to building and supporting NFC-based services will be partly based on the number of customers with devices that can use the technology, it will be largely dependent on it's librarians having a basic understanding of the technology so that they can research and deploy pilot projects and share their knowledge and experiences. This column describes the basic features of the NFC technology and discusses considerations that can help guide libraries when developing their mobile strategies.

## INFORMATION TRANSFER TECHNOLOGIES

The uses of the available technology to transfer information and data dates back thousands of years including the use of signal fires and smoke signals. More modern technologies that make use of electrical currents to transfer data include Morse's telegraph, Marconi's wireless, and licensed radio stations. While the use of wireless technologies for communications and information transfer was a hallmark of the twentieth century, wireless data communications protocols such as infrared, Bluetooth, RFID, and Wi-Fi have become an essential component of

modern computing devices. While all are used to transfer data, each of these technologies differ in protocol, coverage range and performance.

*INFRARED*

Infrared (IR) is a technology that enables wireless data transfer over short distances between devices, such as computers and printers, without cables or wires. As an optical technology, IR requires a clear line of sight between the communicating devices and unlike other wireless technologies it cannot penetrate through walls. A common application of IR technology is in consumer electronics remote controls. IR protocols are primarily used in consumer electronics, computers, household appliances, medical devices, automotive technologies & commercial services. [1] IR may make a comeback with the development of a "multi-gigabit communication module" that can wirelessly transfer data 46 times faster than Wi-Fi and 1,430 times faster than Bluetooth. [2]

*BLUETOOTH*

Although IR adaptors were common in personal computing devices, the technology was pushed aside as alternatives like Bluetooth emerged. Bluetooth is a wireless personal area network technology based on a specification that was created in the late 1990s. The technology allows for the transfer of data between devices over short distances. [3] Bluetooth uses radio frequencies to create a link between devices rather than line of sight, modulating in the unlicensed 2.4GHz band. To avoid interference with other signals in the band, Bluetooth hops to a new frequency after transmitting or receiving a data packet. Bluetooth is designed to let smaller, more personal

devices communicate wirelessly and has replaced USB cables to make connections between computers and peripherals, data synchronization for mobile devices, wireless headphones, and hands-free mobile phone use.

*RFID*

Radio Frequency Identification (RFID) is a marriage of radio frequency and microchip technologies. [4] RFID enables data transfer from a farther distance than Bluetooth, and unlike IR does so without requiring a line of sight. RFID technology was developed during World War II as a means for Allies to distinguish between friendly and enemy aircraft. The technology was revived in the 1970's by the U.S. government to track livestock and to maintain the security and safety of nuclear materials. [5] The technology moved out of government labs and into the public sector. Many applications of RFID technology have since made their way into our daily lives. Examples include Disney's "Magic Band" which allows visitors to buy goods with a linked credit card, access their hotel room, or pre-register for three FastPasses that let them jump to the front of the line for certain rides. [6]

*WI-FI*

Wi-Fi, (short for "Wireless Fidelity") is a popular technology that allows an electronic device to exchange data using radio waves over a computer network. Defined in the IEEE 802.11 standard, Wi-Fi allows a device to a network resource, such as the Internet, within a range of about 65 feet. [7] While Wi-Fi is most commonly used to connect to the Internet it can also be used to transfer

data, information, or multimedia when included in devices like Apple TV. It can also be used to connect to networked devices like printers. Depending on how the Wi-Fi connection is established, data transfer may not be encrypted and could be intercepted by those 'sniffing' and capturing wireless communications.

## NEAR FIELD COMMUNICATION

Near Field Communication (NFC) is a data transfer standard for a contact-less exchange that takes place over extremely short distances. NFC allows users to perform contactless transactions access digital content and connect to other electronic devices simply by bringing their mobile devices into close proximity.

NFC is a subset of Radio Frequency Identification (RFID), which has been standardized on the ISO/IEC 14443 standard and uses the same 13.56MHz radiofrequency spectrum. Organizations like the Near Field Communication Forum define standard data formats and common operations to facilitate certain applications, such as transferring credit card information, extracting URLs or other information from smart posters. To date, the Forum has released 16 different specifications covering NFC. [8]

NFC communication requires two devices. One device must have an NFC reader/writer and the other must have an NFC tag. An NFC tag is an integrated circuit containing data, connected to an antenna, which can be read and written by the reader. "Passive" NFC tags use the energy from the reader to transfers data, while "active" or "peer-to-peer" tags have their own power source and respond to the reader and transfer data using their own electromagnetic fields. [9] The NFC reader emits a small electric current that creates a magnetic field that is received by

another NFC compatible device, where it is turned back into an electrical current to allow the data transfer. Once the requested data is transmitted, the tag or reader might request additional data or commands. As long as the reader and tag are in close proximity, these data exchanges can occur. The connection is terminated according to either the reader or tag's design once data has been exchanged. Moving the two devices away from each other will also break the connection. [10] NFC can be distinguished from Bluetooth in that the former uses electromagnetic radio fields where the later uses radio transmission. The data exchange used by NFC is similar to Bluetooth except that instead of pairing devices NFC wirelessly the connectivity is established by touching the reader/writer and the tag together.

While the incorporation of NFC into cellphones holds the most promise, NFC can even take advantage of any of the functionality of larger device such as tablets, laptops, or desktop computers, printers, audio/video players, appliances, and consumer electronics when it is incorporated into those devices. A significant number of commercial entities have already adopted the technology, including McDonalds, The Home Depot, and CVS. [11]

## WHAT CAN NFC DO?

NFC can perform similar object hyperlinking applications as barcodes, QR codes, and RFID do currently including embedding information in posters, stickers, and other physical items. While such activities could also be accomplished using other technologies like QR codes, NFC has the capability to provide much more data and to perform specific tasks.

QR codes have become commonplace on conference and advertising posters. An poster that utilizes NFC can come in many forms – as a poster, billboard, or a magazine page. [12] NFC Smart posters can be used to promote media downloads, books, or any other item. If a user likes

what they see on the poster they can wave their mobile device over the embedded tag. For example, a movie poster might identify nearby theaters showing the movie, provide show times, and allow the user to purchase tickets. A conference poster could be used to interact with content contained within the poster.

NFC can also be program to do specific tasks. For example, Samsung TecTile is an application that reads and writes custom NFC tags that can be used to change settings on a phone, launch applications, update social network status, or make phone calls or send text messages. [13] Once created, a TecTile is placed in a convenient place and requires a tap of the phone to the TecTile to perform the actions. Placing a TecTile on a bedroom nightstand could put it automatically into Do Not Disturb mode. Similar systems include Tagstand's NFC Task Launcher and Sony's Xperia SmartTags. [14] [15] These service customer tags can be used to turn on or off Bluetooth if they scan a tag in their car, turn on or off Wi-Fi , set the phone's ringer to vibrate, dim the display and set an alarm from a tag placed on a night stand, or turn off work email with a tag just inside a home's door. [16]

NFC tags can also be built into three-dimensional objects. Embedding NFC tags into consumer products, such as appliances, that link to product information and online manuals would also be ideal for in-field service or home repair. The company Objecs markets "technology enabled granite artifacts" including a product called the RosettaStone. made out of black granite, the stone has an embedded tag. The information associated with each tag is uploaded and managed by the buyer using a data archive site. Touching an NFC-enabled phone to the stone provides additional information. The memorial industry has begun to adopt this technology since each tag has a unique ID number. Having a unique ID number on a grave marker carries a number of advantages for researchers using web-based genealogy and memorial

sites. [17]

Built in security features allow NFC to be used for cashless payments or paperless ticketing. Eventually loyalty cards, gift cards, coupons, and receipts will be able to be stored on mobile devices using similar applications. The most common application is the fast-lane point-of-sale payments at gas stations and supermarkets using card-based services like Mastercard PayPass. [18] Another example is Google Wallet, an Android app that makes "your phone your wallet." [19] Wallet stores virtual versions of existing plastic cards that are used to pay by simply tapping the phone to the reader. A four digit PIN is required to access a phone's financial data which reduces concerns of its use if a phone is stolen. The user can clear card and transaction data off their phone by remotely disabling the Wallet app. NFC technology is also being used for services such as mobile ticketing. Countries including Singapore, Japan and the UK use NFC in their public transportation systems. In Europe, the transport industry has already converged around the interoperable Calypso contactless ticket standard, addressing the compatibility issues that plague NFC applications. [20]

Finally, NFC can also be used for various access control systems. In 2012, Villanova University piloted an NFC-based mobile key service developed by Ingersoll Rand Security Technologies. The technology allows people to use their phones to enter buildings in place of physical keys or contactless ID badges by sending access control credentials over the air to NFC phones, Ingersoll Rand produced a video showing how the students are using their mobile phones to gain access to dormitories, academic buildings and administrative offices, as well as how the mobile credentials are issued to the students. [21]

## NFC AND LIBRARIES

Libraries have investigated and implemented wireless data transfer technologies with wide range level of success. [22] As customers begin to use their NFC enabled smartphones for more and more transactions, they will soon expect to be able to use them at libraries like they can at the stores or gas stations. While NFC may be considered to be just another wireless technology it is one that has potential applications in the delivery and support of library services and should be investigated and piloted. While still very early in the research and adoption stage, NFC has the potential to augment many existing library services.

*eLibrary Cards*

Implementing some method to identify and verify a library customer would need to be an essential step in the deployment of any NFC services, whether it needs to be a physical NFC enabled identification card or one which is electronically embedded into a device. Since the library often doesn't have any input into institutional ID systems early NFC adopters will need some sort of a parallel ID system. At the 2013 North American International Auto Show, auto manufacturer Ford has a promotion program utilizing the Ford Blue Oval card. [23] Each attendee interested in the promotion entered their information at a kiosk and it was associated with a serial numbered card. The card has a tag allowed attendees to tap to you to 'Like' and save digital content, including videos, to view later online. The card enabled attendees to vote for a favorite car, win prizes, and share experiences with friends. While such an on-site on-the-fly system would not be the best for extending borrowing privileges unless it was integrated into the

integrated library system, such of an approach it could be used for other library promotions and services.

*Material Check Out / Authentication*

Libraries continue to look for new methods for allowing users to check out their own materials in an effort to reduce reliance on stationary checkout desks, reducing lines and wait times, and reallocation of staff to other service areas. With a secure NFC ID solution in place, an application installed on NFC-capable mobile device, and with materials identified with NFC tags, customers could literally checkout materials from any location within the library as soon as it is taken from the shelf. Customers could even check the due date or extend the lending period and manage their materials from wherever they are. Bibliotheca, a vendor that provides similar solutions including those using RFID, already markets has such a system. [24]

Libraries have used many different techniques over the years to authenticate customers at public access computer terminals. Many libraries have small group study rooms that require registration or key access. With a NFC enabled ID or registered device and a card reading station, customers could access workstations or study rooms in the same way one would use a smart wallet at a retailer, eliminating the need to remember or enter a username and password combination. Of course, the use of a PIN code would provide an extra level of security. Integration with an online signup system could also activate and deactivate individual access permissions.

*Expanding the Collection*

There are many possibilities for NFC to be used to help customers interact with collections. Individuals with enabled devices could touch it to kiosks located throughout a library to receive resource recommendations based on their subject interests, past transactions, or a predefined profile. Supplemental information could provide details about a resource or object, including background information about the author/creator, access to related multimedia, connections to online links, or to display related resource guides. While technologies such as QR codes could also be used to access such supplemental information, they generally perform a single function or reroute to a single resource. NFC, on the other hand, has the capacity to perform multiple functions based on the functionality of the reader software.

*Marketing and Promotions*

There are a number of potential uses for NFC to market and promote the library. A library's social media presence could be facilitated through quick check-ins using services that are NFC enabled services, such as Google Plus or Foursquare. People attending library-sponsored events could check in via NFC, much like attendees at the 2011 Google I/O conference. [25] Attendees at the 2013 Manhattan Cocktail Classic were given a Digital Goodie Bag that included an NFC-enabled wristband. The band allowed attendees to keep track of every drink they sampled by tapping their band against an NFC reader stationed atop each bar. After the event attendees received a personalized email with the recipes of the beverages they tapped their band against. Attendees also were able to link their bracelets to Facebook and Twitter accounts. The bracelets then allow instant upload of pictures taken photo booths, check-in on Facebook Places, sending of Tweets, and tap-to-"Like." [26] Attendees were even able to interact with each other using NFC

solutions like NFriendConnector. [27] NFC-based games could be used in libraries to increase traffic or highlight services. Players who tap on a certain number of tags get to another level and earn points and bonuses that could be traded in for preferred seating or a private study room.

## GENERAL CONSIDERATIONS

As is often the case with emerging technologies, NFC the adoption rate in the US has been low. As of this writing, few devices on the market have NFC chips. However, the number of NFC enable devices continues to grow. An estimated 285 million NFC-enabled devices will be shipped in 2013, including both cellular handsets and other consumer electronics, with the number in circulation reaching 1.95 billion by 2017. [28] Another challenge with the adoption and investigation into NFC is that the market and standards are currently fragmented. The introduction of services like mobile wallets is being hampered by vendors offering NFC solutions with different architectures. This fragmentation may have been the reason that Apple chose not to include NFC into the iPhone 5. Instead Apple will forge its own path with the launch of Passbook, which is not NFC-based, in the release of iOS 6. PayPal, which had been experimenting with NFC, ditched their research into the technology when it launched its in-store mobile payment app that only requires users to type in a PIN to access their PayPal accounts. There will eventually come a point at which the fragmented environment will consolidate.

As with all wireless transfer solutions, security and privacy issues also exist with NFC. While the proximity between NFC reader and tag provides some level of protection, the use of PIN codes and methods of disabling chips can provide an additional level of security. Still, even the U.S. Department of State recommends using an RF blocking material when traveling with

their e-Passports. [29] [30] The reality is that no security model or solution can currently overcome these problems. Protecting the customers and reducing their risk and exposure requires either assuming the risk or by utilizing solutions like real-time fraud prevention similar to what financial institutions and credit-card companies deploy. Similarly, if a virus can theoretically broadcast itself utilizing a wireless data transfer protocol. One such scenario might include a virus that utilizes vulnerabilities in the NFC software on the wireless device or a service related to the communication protocol. Once another system accepts this transmission it could transfer control of the application and data.

While a library's decision to allocate resources to building and supporting NFC-based services will be partly based on the number of customers with devices that can use the technology, it will be largely dependent on the availability of pilot projects that demonstrate the potential of the technology and positive return on investment. In the end, the implementation of NFC in libraries requires libraries that are willing to research and deploy pilot projects and sharing their knowledge and experiences in order to help the library community understand the potential of NFC technology. [31]

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